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## ILLINOIS MINERS' AND MECHANICS' INSTITUTES

R. Y. WILLIAMS, DIRECTOR

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BULLETIN No. 2

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## OUTLINE OF PROPOSED METHODS



PUBLISHED BY THE UNIVERSITY OF ILLINOIS  
URBANA, ILLINOIS





The Illinois Miners' and Mechanics' Institutes were established by act of the State Legislature, Senate Bill No. 259, approved May 25, 1911. An appropriation of \$15,000.00 per annum to carry out this authorization was included in House Bill No. 895, approved June 30, 1913.

The purpose of the Institutes, as stated in the act, is "to prevent accidents in mines and other industrial plants and to conserve the resources of the state."

In the development of this purpose, any and all means may be employed which promise "to promote the technical efficiency of all persons working in and about the mines and other industrial plants and to assist them to better overcome the increasing difficulties of mining and other industrial employments."

The administration of the Institutes is vested in the Trustees of the University. The Trustees have appointed a Director and have placed the Institutes under the general supervision of the Department of Mining Engineering of the University of Illinois.

For copies of bulletins, or other information, address the Director, Illinois Miners' and Mechanics' Institutes, Urbana, Illinois.



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*Introduction.*

In Illinois, there are 79,411 men working in and about the coal mines. Only two other states have a larger production of coal than has Illinois, and in no other state is there as much unmined bituminous coal as there is in this state. Recognizing the importance of the coal industry in the present as well as the future development of Illinois, the State Legislature has enacted a number of laws to prevent accidents to the miners and to conserve the natural resources.

The Illinois Miners' and Mechanics' Institutes, established by the 47th session of the Legislature, was given authority to plan and power to execute any and all means "to promote the technical efficiency of persons working in and about the mines, and to assist them to better overcome the increasing difficulties of mining." Every man about the mines, therefore, should look upon these Institutes with a sense of proprietorship and should be sufficiently interested to inquire into the details of this endeavor and to offer suggestions for improvements that will make for safety and efficiency at the coal mines.

This preliminary bulletin gives an outline of the methods that can be made to accomplish the purpose for which the Institutes were established. Success can be obtained only with the hearty co-operation of the men at the mines. It makes no difference what may be a man's age, education, or practical experience, there are interesting fields of investigation with which he is not familiar. The mine manager, who has forced his way to the top of the ladder at a particular mine, should realize that other ladders lead higher than those he has climbed and that he must show results before he can become general manager. If after becoming general manager he considers his goal won and fails to progress further, he will soon find that a more progressive man has superseded him.

After reaching a position of responsibility, a man owes to his fellows a certain interest in their advancement and should look upon it as a duty to give of his experience to others.

The aim of the Illinois Miners' and Mechanics' Institutes is not only to increase a knowledge of the science of mining and to interpret fundamental principles, but is also to offer a clearing house for the exchange of practical methods, to increase the earning power of the miner and the efficiency of the company man, and to safeguard life and property.



The general methods which will be adopted have been modeled after those that have been used most successfully in other states and countries. Special details must be worked out to make their application of the greatest benefit under the conditions which exist in Illinois. Attention should be called to the fact that the mines in this state are scattered over a large territory and that the expense of reaching all of them will be too great for the present appropriation. An endeavor will be made to concentrate the work on those methods which will accomplish immediate results.

Friend Reader; after you have looked through this pamphlet, please drop a line to the Director of the Illinois Miners' and Mechanics' Institutes and give him the benefit of your suggestions. He is intensely interested in this new work; he wants the Institutes to be of maximum service to the miner and to be their best friend. So send in your criticism, and do not fail to give a substitute suggestion for the features you do not like.

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The outline of methods proposed for carrying out the work of the Illinois Miners' and Mechanics' Institutes may be grouped under the following heads;

1. Two-year course of systematic instruction at mining centers.
2. Short course at the University.
3. Unit courses in mining towns.
4. Co-operation with existing organizations.
  - a. With the State Mining Board and Inspectors.
  - b. With the Mine Rescue Commission.
  - c. With miners' locals.
  - d. With the United States Bureau of Mines.
  - e. With high schools and public schools.
  - f. With libraries in mining towns.
  - g. With first aid or other local organizations.
5. Special activities.
  - a. Organization of local institutes.
  - b. Question and answer department.
  - c. Traveling libraries, laboratory equipment, etc.
  - d. Work for non-English speaking miners.
  - e. Correspondence courses.



1. *Two-year course of systematic instruction at mining centers.*

The general mining law of Illinois requires that all state mine inspectors, mine managers, mine examiners and hoisting engineers shall be certified by the State Mining Board as having passed examinations as to their practical and technical knowledge of different phases of the development and operation of coal mines. It is one of the primary aims of the Illinois Miners' and Mechanics' Institutes to lend assistance to men who are ambitious to prepare themselves for these positions of responsibility.

It is recognized that a man who works hard at the face is unable to study for long concentrated periods without becoming discouraged. It is, therefore, planned to have the general course, which is designed to cover all the practical details required in the examination by the State Mining Board, extend over two years, so that a man who receives a certificate from the Illinois Miners' and Mechanics' Institutes should be able to pass the examinations of that Board.

By extending the course over two years, a man is able to continue full time at work while obtaining the required technical knowledge. In this way he is increasing his practical experience and obtaining the necessary knowledge of the theory of mining, both of which will be of advantage to him in the position of enlarged responsibility for which he is striving.

This course should not be limited to men who desire state certificates. The man who is dissatisfied to remain all his life familiar with only one part of mining, and wants to have a general knowledge that will permit him to choose those jobs underground which will yield him the maximum return for his efforts; the man who wants to know the best and safest methods that have been devised for any particular purpose; and the man who has ingenuity for suggesting new ideas, will find that this course will be of great practical benefit.

Men who take this course will be identified with the progressive movement for safer and saner mining in Illinois. Those who show ability in this work will find that their services will be made of greater value, and that they will be sought out for the desirable positions about the mines. Twenty years ago, it was said that anyone could farm, and that anyone could mine coal. While these statements are still true, the men who are today successful in farming and in mining are the men who have recognized the necessity of combining practical experience and technical knowledge to fit them for their struggle to the top. The Illinois Miners' and Mechanics' Institutes will watch with interest the progress of the men receiving certificates and will do everything possible to further their advancement.

In conducting this course, the Institutes will endeavor to secure from among the qualified men at the mine those who will have charge



of the instruction along strictly practical lines, and to furnish in addition a man technically and practically trained who will devote his whole time to the work and who will, in addition to his work as instructor, review all current news items, digest the more important methods applicable to coal mining, and present them to the evening meetings so that the work may be kept strictly up-to-date.

The course itself will be handled differently from the usual method of teaching, getting as far as possible from the idea of a class room and consisting more of general discussions of the subjects, where the instructor acts as the chairman of the meeting. Subjects for discussion will be announced in advance, reference books will be available at the local headquarters of the Institutes, and the men, as well as the instructors, will prepare themselves for a general consideration of the subject and for an exchange of ideas.

Such fundamental and elementary subjects as chemistry, mechanics, physics, drawing and English composition will be considered in connection with their application to the different phases of the development and operation of coal mines.

It is planned in each place to hold two meetings each week and to spend two hours at each meeting. If a man taking this course will spend a like amount of time at home or in the mine thinking about the subjects under consideration, he should be able to receive certificates both from the Illinois Miners' and Mechanics' Institutes and from the State Mining Board. In addition, he will "know that he knows" the general principles of coal mining and will be better qualified for positions of trust and responsibility.

## THE INSTITUTE CALENDAR 1914-1915

### AS APPLICABLE TO

#### *The Two-Year Course.*

##### First Term—14 weeks:

February 2, 1914, to May 9, 1914.

Examination period, May 11 to 15.

##### Second Term—14 weeks:

October 5, 1914, to January 23, 1915.

(Christmas Vacation, Dec. 20 to Jan. 3.)

Examination period, January 25 to 29.

##### Third Term—14 weeks:

February 1, 1915, to May 8, 1915.

Examination period, May 10 to 14.

##### Fourth Term—14 weeks.

October 4, 1915, to January 22, 1916.

(Christmas Vacation, Dec. 19 to Jan. 2.)

Examination period, January 24 to 28.



List of subjects and the time devoted to each subject in the two-year course.

Group	Number of course	Subject	Number of Evening Sessions
A	1	Methods of mining.....	10
	2	Timbering .....	5
B	3	Ventilation .....	8
	4	Mine gases and safety lamps.	5
	5	Special underground rooms..	2
C	6	Geology .....	5
	7	Surveying .....	10
D	8	Coal, a fuel.....	5
	9	Surface plant.....	5
	10	Steam .....	5
E	11	Hoisting .....	7
	12	Haulage .....	8
F	13	Fire protection .....	5
	14	Electricity .....	10
G	15	Drainage .....	6
	16	Explosives .....	9
		Review .....	7
		Total.....	112

The subjects in the above list have been arranged in seven groups, each of which will require fifteen evening sessions for lectures and discussions and one session for review, or a total of eight weeks for the completion of the courses in any group. A person interested in mining may enroll for any number of these groups and will receive credit for the work accomplished.

Group "D," "E" and "F" have been specially designed to assist a person who intends to apply for certification as hoisting engineer.

Safety, efficiency, conservation, and the state mining law, will be considered in their special application to each of the above topics.

First aid and rescue work will be given in co-operation with the Mine Rescue Commission.

The following complete schedule of the two-year course shows in detail the topics considered under the subjects.



1. *Methods of Mining.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Systems of mining</i> Room and pillar Longwall Panel <i>Modifications</i> in case of Steep pitches Clay veins Very soft coal Flushing Surface subsidence <i>Undercutting</i> By hand By machine Electric Compressed air Pneumelectric <i>Shooting off solid</i> <i>Methods of advancing in</i> Narrow work Wide work Long wall face	<i>Mine mapping</i> <i>Explanation of</i> Plan Elevation Sections <i>Sketch the</i> Placing of shots	<i>Measurement of</i> Length Area Volume <i>Fractions; above</i> measurements to be expressed in vulgar and decimal fractions <i>Percentage of</i> recovery to be calculated <i>Proportion of</i> undercutting to total height and to tonnage pro- duced	<i>Specific gravity of</i> coal <i>Pressure of roof</i> per square inch <i>Compression on</i> pillars, props <i>Tension on collars</i> and beams <i>Loss of energy in</i> compressed air due to Heat developed under com- pression <i>Increase of vol-  ume because</i> of the heat <i>Friction of air</i> in pipes	Given typical min- ing conditions, Report on some suitable mine plan Summary of <i>Advantages and</i> <i>Disadvantages</i> of machine min- ing

2.—*Timbering.*

Mining Practice	Drawing	Mathematics	Sciences	English
<i>Classification of mine timber</i> Strength Weight Elasticity Life Cost <i>Methods of timbering</i> Rooms Entries Shafts Bottoms Special <i>Preservation of timber by</i> Water Salt solution Sulphate of copper Sulphate of iron Chloride of zinc Creosote Whitewashing Carbolineum Tar <i>Steel "timbering"</i> Comparison with wood as to Strength Life Cost Use <i>Recovery of timber</i> Methods Safeguards	<i>Plan, elevation</i> <i>section of</i> Part of hoisting shaft Timber sets	<i>Calculate</i> Breaking load and Safe working load for <i>Timber collars</i> Round section Square sec- tion Rectangular section <i>Timber props</i> Round sec- tion Square sec- tion Rectangular section	Tension and com- pression Growth of bacteria causing dry rot in wood Oxidation causing rust of steel timber	Report on the means for han- dling props at local mine



### 3. Ventilation.

Mining practice	Drawing	Mathematics	Sciences	English
<p><i>Practical notes on</i></p> <p>Fans</p> <p>Settings and housings</p> <p>Arrangements for reversing the air</p> <p>Quantity produced under given water gauge</p> <p><i>Conducting air to the face in</i></p> <p>Longwall mines</p> <p>Room and pillar mines</p> <p><i>Overcasts</i></p> <p>Construction</p> <p>Cost</p> <p>Advantages</p> <p><i>Stoppings</i></p> <p>First cost</p> <p>Maintenance</p> <p>Renewals</p> <p>Emergency repairs</p> <p>Cost of air leaks</p> <p><i>Doors</i></p> <p>Construction</p> <p>Automatic doors</p> <p><i>Regulators</i></p> <p>Construction</p> <p>Maintenance</p> <p><i>Handling noxious gases</i></p> <p>Dilution with air</p> <p>Piping to surface</p> <p>Sealing old works</p> <p><i>Methods of humidification</i></p> <p>Water car</p> <p>Calcium Chloride</p> <p>Water hose</p> <p>Sprays</p> <p>Steam</p> <p>Exhaust</p> <p>Live</p>	<p>Precise plan, elevation and section of</p> <p><i>Fan housing</i></p> <p>Sketches of</p> <p><i>Stoppings</i></p> <p><i>Overcasts</i></p> <p><i>Regulators</i></p>	<p>Measurement of</p> <p><i>Air currents</i></p> <p><i>Temperature</i></p> <p><i>Humidity</i></p> <p><i>Barometer</i></p> <p><i>Water gauge</i></p> <p>Derivation and use of the</p> <p><i>Ventilation formulas</i></p> <p><i>Splitting formulas</i></p>	<p><i>Power applied</i></p> <p><i>Mine resistance</i></p> <p><i>Velocity produced</i></p> <p><i>Kinetic theory</i></p> <p><i>Evaporation</i></p> <p><i>Condensation</i></p> <p><i>Temperature</i></p> <p><i>Humidity</i></p> <p><i>Dew point</i></p> <p><i>Latent heat</i></p> <p><i>Specific heat</i></p> <p><i>Specific gravity</i></p> <p><i>Density</i></p>	<p>Description of</p> <p><i>Overcasts</i></p> <p><i>Stoppings</i></p> <p>Explanation of</p> <p><i>Humidification</i></p> <p><i>Water gauge</i></p> <p><i>Anemometer</i></p>



4. *Mine Gases and Safety Lamps.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Practical notes on mine gases</i> Oxygen Nitrogen Methane Carbon dioxide Carbon monoxide Ethane Sulphureted hydrogen Sulphur dioxide  <i>Testing mine air with</i> Safety lamps Canary birds Mice Pigeons Chemicals  <i>Safety Lamps</i> Types of lamps Use of lamps Care of lamps  <i>Laboratory tests</i>  <i>Electric lamps</i> Safety Cost Recharging	Sketch an Orsatt apparatus	Calculation of percentages of various gases in given vol- ume of venti- lating current	Chemistry of Mine gases The underlying principle of safety lamps Oxidation Diffusion Laws of Temperature Pressure Volume Transpiration	Describe a given safety lamp

5. *Special Underground Rooms.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Practical notes</i> on the Design Lighting Heating Equipment Location of the following rooms Manager's office Lamp room Motor or tool shop Refuge chambers	Draw an escape map, showing size and loca- tion of special rooms	Calculate cost per ton for maintenance of hospital	Principles under- lying suffoca- tion	Recommendations for an under- ground hospital



## 6. Geology.

Mining practice	Drawing	Mathematics	Sciences	English
<i>Classification of rocks</i> <i>Geological formations</i> <i>Igneous rocks</i> <i>Sedimentary rocks</i> <i>Carboniferous formation</i> <i>Coal formations</i> <i>Classification of Illinois coals</i> <i>Records of wells, etc.</i> <i>Explanation of terms</i> Strike Dip Fault Cleat Cleavage Faces and Butts, etc. <i>Useful minerals</i> associated with coal <i>Ferns, fossils, etc.</i> <i>Quantity of coal</i> In Illinois Particular counties <i>Prospecting</i> Mountainous country Flat country	<i>Sketches of</i> rolls faults, etc. <i>Drawing of</i> Columnar sections <i>Symbols for</i> Various strata <i>Use and interpretation of</i> Contour lines	Measurement at the face of the coal Combination of several measure- ments to find the average for the bed Nature of a vari- able From measure- ment of bed, find tonnage per acre in place and re- coverable	Chemical elements Useful and pre- cious minerals —their origin, occurrence and distribution Some simple chemical reac- tions	Description of geological con- ditions in a particular coal district in Illi- nois

## 7. Surveying.

Mining practice	Drawing	Mathematics	Sciences	English
<i>Use and adjustments of</i> Compass Transit Y-level Level rods <i>Keeping notes of</i> Angles Horizontal distance Vertical distance Inclined distance Side notes <i>Practical methods</i> with or without instruments of Turning angles Setting out curves Putting up sights Shaft plumbing <i>Underground string illumination</i> <i>Special underground problems</i> <i>in surveying</i> <i>Interpretation of mine maps</i> contours, etc.	<i>Mapping</i> Mine workings Surface prop- erty <i>Plotting</i> Protractor Coordinates	<i>Elementary</i> <i>Trigonometry</i> Sine Cosine Tangent Calculations to reduce field notes to map data	<i>Magnetism</i> Magnetic de- clination Gravity Pendulum in shaft plumb- ing	Suggest an equipment for mine surveying



8. *Coal, a Fuel.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Classification of coals</i> Anthracite Semi-Anthracite Semi-Bituminous Bituminous Lignites Peat  <i>Relative value of steam coals</i> determined by Chemical analysis Combustion in calorimeter Trial in steam boiler  <i>Different furnaces for different coals</i>  <i>Practical notes on the preparation of coal</i> Screening Washing Coking Briquetting By-products Weathering of coal  <i>Dust explosions</i> Conditions Methods of rendering dust inert Water Slate barriers Loading out dust Testing relative dangers of different coal dusts	Fire box of a boiler  Shale barrier installation	Work out examples as to heat value of coals from chemical analysis	<i>Chemical elements in coal</i> Carbon Oxygen Hydrogen  <i>Theory of combustion</i>  <i>Proximate analysis for determining</i> Moisture Volatile matter Fixed carbon Ash  <i>Determinations for</i> Sulphur B. t. u.  <i>Specific gravity of coal</i>	Describe The propagation of a coal dust explosion  Compare Anthracite and Bituminous coals

9. *Surface Plant.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Grouping of buildings</i> <i>Design of buildings</i> <i>Type of construction for</i> Tipples Engine room Boiler plant Smith and carpenter shops Tool and supply house Oil storage Powder house Superintendent and engineer's office Stable and stable supply house  <i>General yard arrangement</i> Empty R. R. tracks Loaded R. R. tracks Mine car tracks Coal storage  <i>Fire protection</i> Design and grouping of buildings Water supply Chemical extinguishers	Design of Powder house Sunken oil tank	<i>Calculations for foundations</i> Tipples Engines Buildings  Reduce the first cost of the surface plant to the cost per ton	<i>Strength of materials</i>  <i>Compression and tension</i> Timber Iron Steel Brick Cement mortar Cordage Wire ropes Limestone Sandstone Concrete  <i>Effect of heat and cold</i>	Report on Fire hazards at local mine



# 10. Steam.

Mining practice	Drawing	Mathematics	Sciences	English
<p><i>Types of boilers</i></p> <p>Cylindrical Flue Tubular Water tube Special forms</p> <p><i>Efficiency depends on</i></p> <p>Material Workmanship Design Ratio of heating surface and grate-surface to horsepower Settings High pressure Suitability of fuel</p> <p><i>Chimneys</i></p> <p>Construction Area Height Stability</p> <p><i>Boiler explosions</i></p> <p>Causes Preventatives</p> <p><i>Smoke prevention</i></p> <p>Proper design Mechanical stokers Coke firing Down draft Baffle plates Air flues in side wall</p> <p><i>Scale incrustation</i></p> <p>Causes Methods of preventing Removal</p> <p><i>Transmission of steam</i></p> <p>Size of pipes Loss in heat due to Friction Radiation Pipe coverings Expansion joints Water traps</p> <p><i>Care of boilers</i></p> <p>Practical notes on Firing Cleaning Inspecting, etc.</p>	<p><i>Draw a</i></p> <p>Plan Elevation and Section of a Boiler setting</p>	<p><i>Calculations on</i></p> <p>Coal per hour Horsepower Heating surface Grate area Size of pipes Flow of steam through pipes Chimney dimensions Cost of horsepower per hour and per annum</p>	<p><i>British thermal unit</i></p> <p><i>Specific heat of steam</i></p> <p><i>Latent heat of steam</i></p> <p><i>Meaning of</i></p> <p>Dry steam Wet steam Saturated steam Superheated steam</p> <p><i>Relationship of</i></p> <p>Grate area to heating surface Heating surface to horsepower Coal per horsepower</p> <p><i>Laws of Evaporation</i></p> <p><i>Flow of steam through pipes</i></p>	<p><i>Report on a</i></p> <p>Boiler explosion</p>



11. *Hoisting.*

Mining practice	Drawing	Mathematics	Sciences	English
Details of installation <i>Cages</i> Platform Self-dumping Skips Buckets <i>Guides</i> Wire rope Wood Steel <i>Cage rests</i> Bottom landing Surface landing <i>Sheave wheels</i> Size Bearings, etc. <i>Wire ropes</i> Size, etc. Strength Life Lubrication <i>Method of signalling</i> Pull wire Pneumatic Electric Signals from cage <i>Hoisting engine</i> Foundations Size and H. P. Discussion of several types Hoisting indicator <i>Hoisting drum</i> Cylindrical Conical <i>Safety features</i> vs. Overwinding Safety gates Safety catches Detaching hooks Cut-off gears Cage speed <i>Caging facilities</i> Arrangement of roads on bottom and top . Car dogs Steam rams Holmes' hoist <i>Counterbalancing</i> Tapering rope Counterpoise system Loaded wagon system Endless rope system Flat ropes Conical drums Koepe system Whiting system <i>Shaft sinking</i>	Draw Hoisting engine foundation from measurements Draw shaft bottom arrangements	Horse power required to raise a given load at given speed, dead load and in balance <i>Calculate</i> Size of engine Size of drum Speed of cage Speed of piston Strains due to slack rope	<i>Frictional resistance in</i> Drum Sheave Guides Engine Mechanics Force Unit of force Inertia Newton's law of motion Parallelogram of forces	Report a fatality due to break in hoisting cable Explain hoisting in balance



## 12. *Haulage.*

Mining practice	Drawing	Mathematics	Sciences	English
<p><i>Types and care of haulage</i></p> <p>Mule</p> <p>Electric motor</p> <p>Compressed air locomotive</p> <p>Gasoline locomotive</p> <p>Steam locomotive</p> <p>Wire rope</p> <p>Gravity plane</p> <p>Engine plane</p> <p>Tail rope</p> <p>Endless rope</p> <p>Cable tramway</p> <p><i>Trackage</i></p> <p>Gauge</p> <p>Weight of rails</p> <p>Ties</p> <p>Fish plates and bonds</p> <p>Curves</p> <p>Grades</p> <p>Alignment</p> <p>Switches</p> <p>Surfacing</p> <p>Ballast</p> <p>Signals</p> <p>Trolley wire installation</p> <p><i>Care of roads</i></p> <p>Cleaning roads</p> <p>Drainage</p> <p>Clearances for safety of men</p> <p>Protection of trolley wire</p> <p>Lighting system</p> <p>Dampening the dust</p> <p>Prevention of falls</p> <p><i>Mine cars</i></p> <p>Wheel base</p> <p>Design of body wheels and couplings</p> <p>Life of wood-steel combinations</p> <p>Lubrication</p> <p>Brakes</p>	<p>Sketch details of</p> <p>Trackage</p> <p>arrangements</p> <p>Plan, elevation of a rail joint</p> <p>Profile of haulage grades</p>	<p>Under given conditions, calculate</p> <p><i>Drawbar pull</i></p> <p><i>Pull on the rope</i></p> <p><i>Horsepower for</i></p> <p>Engine on an engine plane</p> <p>Motor haulage</p>	<p>Resistance of car to motion due to</p> <p><i>Roller friction</i></p> <p><i>Gravity</i></p> <p>Principles of</p> <p><i>Pulley</i>, used in the car shops</p> <p><i>Lever</i>, illustrated by placing derailed car on track</p> <p><i>Wheel</i>, on mine cars</p> <p><i>Inclined plane</i> or grade of road</p>	<p>Report on</p> <p>A motor wreck</p> <p>A mine car accident</p> <p>Facts to be given and student to write a report in good grammatical form showing</p> <p>Introduction</p> <p>Statement</p> <p>Cause</p> <p>Result</p> <p>Conclusions</p> <p>Suggestions</p>



13. *Fire Protection.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Protection of surface plant</i> <i>Classification</i> of building materials Non-combustible Fire resistive Inflammable  <i>Grouping of</i> Buildings  <i>Yard cleaning</i> Removal of brush, etc. Disposal of waste  <i>Fire fighting</i> Water storage, piping and equipment Chemicals  <i>Protection of underground workings</i> Consideration of types of construction with cost data for fire proof, fire resistant, and inflammable construction  <i>Handling and storing of combustibles</i> Hay Oils Explosives Cotton waste  <i>Protection of</i> Steam pipes Electric wires  <i>Rescue chambers</i> Number Design Location Equipment  <i>Gob-fires protection</i> <i>Fire fighting methods</i> by Smothering Sealing off Flooding Loading out Flushing  <i>Fire alarms</i> Telephone best Alarm duty Escape maps  <i>Rescue corps</i> Handled by Mine Rescue Commission	Plan of surface plant	Calculate size of equipment for fighting fire with water Storage capacity Head of water Pipe lines Hydrants Hose lines	Principles of combustion Cooling effects of water Smothering and cooling effects of chemicals	How to save yourself in case of a mine fire

# 14. Electricity.

Mining practice	Drawing	Mathematics	Sciences	English
<p><i>Application to coal mines for</i></p> <p>Lighting</p> <p>Signalling</p> <p>Telephoning</p> <p>Blasting</p> <p>Pumping</p> <p>Haulage</p> <p>Coal cutting</p> <p>Ventilating fans</p> <p>Conveyors</p> <p>Hoisting, etc.</p> <p><i>Central station equipment</i></p> <p>Dynamo</p> <p>Direct current</p> <p>Alternating current</p> <p>Armature</p> <p>Insulation</p> <p>Commutation</p> <p>Design of brushes</p> <p>Switchboard</p> <p>Wiring</p> <p>Switches</p> <p>Circuit breakers</p> <p>Instruments</p> <p>Voltmeters</p> <p>Ammeters</p> <p>Wattmeters</p> <p>Leakage detectors</p> <p><i>Transmission of current</i></p> <p>Insulators</p> <p>Aerial conductors</p> <p>Transformers</p> <p>High tension</p> <p>Low tension</p> <p>Taking wires down shaft.</p> <p><i>Underground installation</i></p> <p><i>Cables</i></p> <p>Kind and size for different use</p> <p><i>Motors</i></p> <p>Method of rendering them flame proof</p> <p><i>Earthing of systems</i></p> <p><i>Distribution of lights</i></p> <p><i>Conductors</i></p> <p><i>Care of machines</i></p> <p>underground and making of simple repairs</p>	<p>Sketch wiring for Bell circuit for lighting circuit</p> <p>for trolley wires</p> <p>Draw a Conductor Electric switch</p>	<p>Calculation of</p> <p>Size of cables</p> <p>Drop in voltage</p> <p>H P &amp; Watts</p> <p>Amperes</p> <p>Ohms</p> <p>Volts</p>	<p>Relationship between</p> <p><i>Practical units</i></p> <p>Ampere</p> <p>Volt</p> <p>Ohm</p> <p>Watt</p> <p>Analogies between the flow of water and electricity</p>	<p>Describe the analogy between the flow of water and electricity</p>



15. *Drainage.*

Mining practice	Drawing	Mathematics	Science	English
<i>Methods of drainage</i> Gravity Siphon Pump Water buckets <i>Practical notes on various pumps run by</i> Steam Compressed air Electricity <i>Kinds of pumps</i> Reciprocating Single cylinder - Duplex Centrifugal Vacuum pump Jet pump Injector Hydraulic ram Air-lift pump <i>Flow of water through</i> Pipes Tunnels Flumes <i>Installations of</i> Pumps Mine dams Sumps <i>Handling acid mine water</i>	<i>Sketch pipe lines on the mine map</i> <i>Plan, elevation and section of a Mine dam</i> Piston rod of pump	Formula for flow of water through pipes Ratio of steam and water cylinders in direct acting pumps Theoretical capacity of pumps Horsepower required to raise water	<i>Hydrostatics</i> When a pressure is exerted on any part of the surface of a liquid, that pressure is transmitted undiminished to all parts of the mass, and in all directions <i>Equilibrium of liquids</i> <i>Pressure of liquids</i> <i>Weight of water</i> <i>Transmission of pressure through water</i> <i>Pressure in pipes</i> <i>Hydraulics</i> Derivation of formula for the velocity of a jet of water Horsepower of a running stream Loss in head due to friction	Report on the advisability of driving a tunnel one mile through a hill to a valley of lower level in order to de-water a mine of acid water Describe a mine dam installation

16. *Explosives.*

Mining practice	Drawing	Mathematics	Sciences	English
<i>Manufacture</i> <i>Transportation</i> <i>Storage and use</i> Permissibles Black powder Dynamite Hydraulic cartridge Lime cartridge Roof pressure <i>Results of misuse of explosives</i> Windy shots Blown out shots Fires and explosions Laboratory tests	Plan Elevation and Section of Powder house	Ratio of accidents to tonnage in the different explosions Cost per ton	4 stages of oxidation <i>Retarded</i> Vegetable matter laid under water <i>Slow</i> Vegetable matter exposed to weather <i>Rapid</i> Vegetable matter burning <i>Instantaneous</i> Vegetable matter (coal dust) exploding <i>Illustrate with explosives</i> <i>Properties of explosives</i> Temperature Length of flame Duration of flame Pressure developed Total heat	<i>Presentations of arguments favoring use of permissibles</i>

## 2. *Short course at the University.*

It has been suggested by a number of the coal companies and miners that there are men about the mines who would attend a short course on coal mining at the University of Illinois at Urbana. Accordingly the Department of Mining Engineering at the University of Illinois, through the Illinois Miners' and Mechanics' Institutes, will offer courses beginning April 6 and continuing until May 16, 1914.

This short course should appeal strongly to men who desire to apply to the State Mining Board for certification to the positions of state mine inspector, mine manager, mine examiner and hoisting engineer, because it will permit them to review their technical knowledge of the development and operation of coal mines.

It should be attractive, also, to superintendents, certified men, and others who wish to keep abreast of the times; for the science of coal mining is developing rapidly, measuring its progress with leaps and bounds. No better opportunity for the exchange of ideas on mining can be offered for the busy men about the mines than the short course at the University.

In general, the same subjects will be discussed as have been mentioned in the schedule for the two-year course, and the practical aspects of these topics will be treated in the same manner as in the longer course. But where the men spend full time on this work, the progress will be very rapid, and a great deal of ground can be covered in a short period of time.

For the benefit of those who cannot remain for the full six weeks course, each applicant may register for the particular subjects in which he is especially interested and may receive credit for the work accomplished. In this way, a man who can spend only two weeks at Urbana will be able not only to receive technical training in those subjects which appeal to him most strongly, but he will be able to enter the spirit of the Miners' and Mechanics' Institutes and of the University of Illinois in both of which departments he has a certain proprietorship.

During the short course, four hours each morning will be spent in lectures and discussions which will be conducted by the teaching staff of the University and of the Institute and by practical men from the mines. During three hours each afternoon, courses will be given in the mining laboratory, in surveying on the campus, and in rescue and first aid work at the University Mine Rescue Station. Representatives of both the U. S. Bureau of Mines and the State Mine Rescue Commission will have charge of the rescue and first aid training, and it will thus be possible for men to receive both State and National Certificates for proficiency in these subjects. On Saturday



night of each week, it is planned to hold an informal social session in order that all who are connected with the short course may become better acquainted.

The mining laboratory at the University, which will be available for this course, is very complete. A list of some of the equipment will be interesting to the men from the mines:

1. Coal washing machinery.
  - a. Robinson washer.
  - b. New Century differential motion coal jig.
  - c. Stewart coal jig.
  - d. Coal crushing rolls.
  - e. Swing hammer pulverizer.
  - f. Four-product trommel screen.
  - g. Four-product shaking screen.
  - h. Watson-Stillman briquetting press.
  - i. Sink-and-float testing machine.
  - j. Peck coal conveyor.
  - k. Drying pans.
  - l. Sampling and grinding apparatus.
2. Mining machines.
  - a. Pneumelectric.
  - b. Sullivan puncher.
  - c. Goodman chain.
  - d. Sullivan diamond drill outfit.
  - e. Ratchet-augurs, etc.
  - f. Rock drills.
  - g. Hand-power machines.
3. Mine rescue equipment.
  - a. Draeger.
  - b. Westphalia.
  - c. Fluess.
  - d. Pulmotor.
  - e. Smoke chamber.
  - f. Telephone helmet.
4. Mine safety lamps.
  - a. Davy.
  - b. Wolfe.
  - c. Clanny.
  - d. Mueseler.
  - e. Cambrian.
  - f. Pieler.
  - g. Ackroyd and Best.

- h. Ashworth-Hepplewhite-Gray.
  - i. Marsaut.
  - j. Deputy.
  - k. Carbide lamps.
  - l. Hubbell electric.
  - m. Hirsch electric.
  - n. Proto electric.
  - o. Bull-dog electric.
5. Gas testing equipment.
- a. Oldham gas tester.
  - b. Hailwood gas tester.
  - c. Orsatt analysis cabinet.
  - d. Photometer.
6. Explosives.
- a. Dummy explosives.
  - b. Powder samples.
  - c. Fuses, caps, crimpers, etc.
  - d. Electric blasting machine.
  - e. Thawing cases.
  - f. Complete set of powder screens.
  - g. Sectionalized wooden models of drill holes.
  - h. Testing appliances.
7. Chemical equipment.
- a. Calorimeters, photometers, driers, microscopes, balances, and accessory apparatus for coal analyses and specific gravity determinations.
8. Models.
- a. Steel mine timbers.
  - b. Wood shaft timbers.
  - c. Holmes' steam hoist.
  - d. Coal jigs.
  - e. Ventilating fan.
  - f. Interlocking steel shaft piling.
  - g. Pardee spiral separator.



## THE INSTITUTE CALENDAR, 1914

AS APPLICABLE TO

*The short course at the University of Illinois*

Dates.	Subjects for Discussion*	Laboratory and Field Work
	Morning Sessions 8 a.m. to 12, noon	Afternoon Sessions 2-5 p.m.
April 6-11.....	Geology Methods of mining Timbering	First aid training Drawing
April 13-18.....	Coal, a fuel Surface plant Steam	First aid training Drawing
April 20-25.....	Hoisting Haulage Fire protection	Mine rescue chamber Mining laboratory
April 27-May 2.....	Ventilation Surveying Special underground rooms	Mine rescue chamber Mining laboratory
May 4-9.....	Electricity Mine gases and safety lamps Surveying	Surveying on the campus Safety lamp laboratory
May 11-16.....	Electricity Explosives Drainage	Surveying on the campus Safety lamp laboratory

\*For details of the topics covered under each subject, see schedule for the two-year course.

### 3. Unit Courses in Mining Towns.

A unit course is a term applied to a course where only one subject is taught at a time, and where a considerable interval of time is allowed to lapse before another unit is discussed. It is a method of instruction which gives the miner his next step forward and offers him an opportunity to apply the details of the subject while working in the mines before the next unit is taken up.

In the conduct of these unit courses, a practical mining man will be placed in a district where eight towns will arrange to furnish classes of fifteen or more men. Once every three months the instructor will visit each town in this circuit of eight and give a two-weeks unit course which will consist of two hours work on four evenings each week.

The subjects of the unit courses will be chosen from among those listed above for the two-year course. After the completion of one unit, the men who have taken the course will be permitted to select the topic for consideration at the next unit course three months later. In the meantime, reference books will be made available, members of the course will be asked to prepare discussions of various phases of the subject to be considered, and such interest will be aroused as will make the course appeal to all.

#### 4. *Co-operation with existing organizations.*

##### a. *With the State Mining Board and Inspectors.*

The State Mining Board is vested with the authority to certify men for the positions of State mine inspector, mine manager, mine examiner and hoisting engineer. In part, this certification is based on the technical knowledge of the applicant as shown on examination.

The Illinois Miners' and Mechanics' Institutes, by keeping in close touch with the State Mining Board and the Inspectors, will be able to assist applicants in preparing for these examinations and if requested by the Board will always be glad to present statements of the technical work performed under their auspices.

##### b. *With the Mine Rescue Commission.*

This commission was established "for the purpose of providing prompt and efficient means of fighting mine fires and of saving lives and property jeopardized by fires, explosions or other accidents in coal mines in Illinois" and was authorized to give "instruction in first aid to the injured and similar technical subjects."

By co-operation with this commission, the Illinois Miners' and Mechanics' Institutes will be able to hold lectures and vocational courses in rescue stations and cars. Each of these departments has for its main purpose the prevention of accidents and the conservation of natural resources, and each will assist the other in offering to men engaged in mining Illinois coal a practical and technical training to fit them for profitable employment in this great industry.

##### c. *With Miners' Locals.*

There are many camps in Illinois where the local union headquarters are used not only as the place for the regular meetings, but also as a club where the men convene for social purposes.

If the members of a local union vote to request it, the Illinois Miners' and Mechanics' Institutes will co-operate with them in increasing the club features at their meeting rooms. This may be accomplished by furnishing traveling libraries, by giving occasional lectures on mine safety, and by the organization of local institutes.

##### d. *With the United States Bureau of Mines.*

"The general purpose of the Bureau of Mines is to conduct, in behalf of the public welfare, fundamental inquiries and investigations into the mining industry. The two phases of the industry of greatest national concern are safety and efficiency—safeguarding the lives of our miners and insuring the most efficient and least wasteful development and use of our mineral resources."



This Bureau has signified its willingness to co-operate with the Illinois Miners' and Mechanics' Institutes. It will furnish, free of cost to the men enrolled in the Institute courses, copies of bulletins, technical papers and circulars which refer to the subjects under discussion. Also from time to time, it will detail to this work a lecturer who will illustrate his talk with stereopticon views or motion pictures.

e. *With high schools and public schools.*

The purpose of high schools and public schools is to offer a general education for the "all around development of the individual, the preparation to live well and to appreciate the fine things of life, art music, literature and sciences."

The object of the Illinois Miners' and Mechanics' Institutes is to prepare the individual for profitable employment.

Many of the high and public schools are located in districts where coal mines offer practically the only employment and where many of the pupils are looking forward to work in the mines as soon as the law will permit them to enter. Some high schools in these districts have already requested assistance from the Department of Mining Engineering at the University of Illinois, but were unable to receive help because of lack of funds. It is hoped that an agreement may be made with these schools by which the Illinois Miners' and Mechanics' Institutes can offer assistance as follows:

1. By furnishing bulletins and outlines to the teachers to assist them in giving courses in chemistry, physics, mechanics, geology, etc.

2. By offering instruction to the school pupils in the practice of coal mining in order that they may enter the dangerous and hazardous occupations in the mines with a working knowledge of the rules and regulations established for the safety of life and property.

3. By organizing evening classes for men who are employed during the day in the mines, in order that they may be fitted for more efficient service and more profitable employment in the mines. These classes may take the form of the two-year course, the unit course, or occasional lectures on mining subjects.

f. *With libraries in mining towns.*

A great many books, technical magazines, and bulletins have been published which deal in a practical way with the science and art of coal mining. This literature should be in the library of every mining town.

The Illinois Miners' and Mechanics' Institutes will prepare and circulate lists of these books in the endeavor to interest local libraries, coal operators, and individuals in their purchase.

g. *With first aid and other local organizations.*

For the purpose of rendering immediate assistance to persons injured in and about the coal mines there have been organized in

Illinois a large number of first aid teams and associations. These organizations hold frequent meetings for training and for the discussion of methods of safeguarding life at the mines.

The Illinois Miners' and Mechanics' Institutes salutes the men who are devoting much of their time to this humanitarian work and offers to assist them by furnishing traveling libraries, by giving occasional lectures on mine safety, by arranging evening programs to follow first aid contests, and by the organization of local institutes.

### 5. *Special activities.*

There are a number of special activities in which it should be possible for the Illinois Miners' and Mechanics' Institutes to assist the general movement for safety and efficiency in coal mining. It is too early, and the desires of the men at the mines have not been sufficiently expressed, to permit a complete statement of the methods that will be suggested for carrying on this phase of its work. The following outline, however, will give a general idea of the special features:

#### a. *Organization of local institutes.*

It is believed that local institutes furnish the best opportunity to employers and employees to meet with equal advantage and absolutely on the same footing for the discussion of subjects pertinent to coal mining. These institutes should be entirely self-governing; but the Illinois Miners' and Mechanics' Institutes will be glad to assist in their formation and to take an active part in their conduct by furnishing lecturers, stereopticon equipment, reference books, editorship of papers, and general advice.

A bulletin will soon be issued with suggestions for the organization and management of local institutes in Illinois.

#### b. *Question and answer department.*

The Illinois Miners' and Mechanics' Institutes will acknowledge and attempt to answer all reasonable questions which may be asked. It should be able to be of great assistance in helping to solve the problems at the mines because of its close connection with the following departments at the University of Illinois:

Department of Mining Engineering.

Department of Civil Engineering.

Department of Electrical Engineering.

Department of Mechanical Engineering.

Engineering Experiment Station.

Library of the University of Illinois.

Bureau of Mines.

State Geological Survey.

Co-operative Coal Mining Investigations.



c. *Traveling libraries, laboratory equipment, etc.*

The books and technical papers, which deal in a practical way with the subjects discussed in the two-year, the unit, and the correspondence courses, will be purchased by the Illinois Miners' and Mechanics' Institutes and circulated from town to town as traveling libraries.

In addition to this circulation of literature, the Institutes will maintain a traveling laboratory equipment in connection with its courses, this equipment to contain safety lamps, gas analysis cabinets, surveying instruments, and mechanisms for the demonstration of the practical application of physics, mechanics, and chemistry to coal mining.

d. *Work for non-English speaking miners.*

An increasing number of non-English speaking men are entering the mines in Illinois. These men are ignorant of both our language and our customs and are often entirely unfamiliar with the details of mining.

For these men, the Illinois Miners' and Mechanics' Institutes has a special mission to teach them the rudiments of English and to instruct them with the aid of their own language in the general principles of mining and in the rules and regulations for safety.

e. *Correspondence courses.*

During the period until June 30, 1915, only a small appropriation is available for the conduct of the Illinois Miners' and Mechanics' Institutes. It will be impossible, therefore, to provide regular courses as outlined above for all who may desire to be enrolled in this work.

It is planned when funds are available, as soon as the interest is manifest and as quickly as the details can be worked out, to offer correspondence courses. The lectures which will be prepared for the regular courses will be printed in pamphlets and will form the basis on which the subject of the development and operation of coal mines will be treated through correspondence.

It is suggested that those who are already enrolled in correspondence schools will find that the lectures and courses of the Institutes will assist them in the work that they are doing.

### CONCLUSION

As a final paragraph, the Illinois Miners' and Mechanics' Institutes requests that the men at any particular mine prepare a list of the names of persons who desire technical assistance and submit suggestions as to which of the above methods will be most applicable to the local conditions. In this manner, the organization of the work will be materially helped and results will be immediate.











